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Marshall Space Flight Center

Hydrostatic Liquid-Bearing for Precision Gyro

Prototype units of a hydrostatic liquid-bearing for a precision gyro were designed, constructed, and tested for comparison with counterpart gas-bearings. The results of the tests on the hydrostatic liquid bearing in a precision gyro showed that the unit, with only a 2W power increase and slightly larger overall dimensions performs as well as or better than its gas-bearing counterpart.

The hydrostatic liquid-bearings were built by reworking serviceable gas-bearing components (sleeves, endplates, and cylinders). The liquid (Freon) in each unit is recirculated by means of a spiral-groove pump located within the sealed, self-contained system. The pump was designed for minimum size and power consumption, consistent with the pressure and flow requirements of the bearing.

The working liquid for the bearing enters the pump at the inside diameter of the rotor, runs radially outward along the spiral grooves as the result of viscous shear, and exits from the pump through two outlet ports at the periphery. The liquid flows through two micropore outlet filters, into a sleeve, through two rows of radially directed orifices containing micropore restrictors, into the bearing gaps between the sleeve and cylinder, past the stepped end plates, out the two pump exit ports, and back to the inlet side of the pump (through the same type of micropore filters) where it is recycled. The hydrostatic bearing operation is exactly the same as that of a gas-bearing gyro, except that the working fluid is a liquid.

A unit of this type combines the desirable characteristics of both gas-bearing and floated components. It is a sealed, self-contained package, requiring no cumbersome gas supply system, and is impervious to contamination from external sources. The inherent liquid damping and the added support provided by the liquid buoyant force are not found in gas-bearing units. The hydrostatic bearing, as opposed to the conventional floated-component gyro, is self-centering, requiring no magnetic suspension or centering jewel. The absence of a magnetic suspension eliminates the need for elaborate electrical trimming networks, so that gyro performance is primarily dependent on mechanical design.

The excellent performance obtained in tests on the liquid-bearing, as well as its many desirable characteristics, recommends it for use in place of gas-bearing (or floated components) in inertial systems.

Note:

The following documentation may be obtained from:

National Technical Information Service
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.95)

Reference:
NASA-CR-102991 (N71-17319), Hydrostatic Fluid Bearing Gyro

Patent status:

No patent action is contemplated by NASA.

Source: R. J. Sgambati of
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